PRESSED CURRENT GROUNDBED DESIGN
FULLER ST

IMPRESSP.WK4

Resistivity: 25000 ohm-cm

			MATERIAL COST		
Anode Type:			Anode:	1	ea.
Anode Dia:	3	in.	Anode Cbl:	0.1	$/ft
Anode Length:	120	in.	Hdr Cbl:	1.25	$/ft
# of Anodes:	11		Splice:	25	
Anode Spcng	20	ft.	INSTALLATION COSTS		
Dist. Remote	200	ft.	Trenching:	4.4	$/ft
			Anode Inst:	252	per anode
	SIZE		Splc Inst:	15	per splice
Hdr Cable:	0	AWG	Power Cost:	0.1	$/kwh
			Electric	1000	
Header length	800		Rectifier	200	
			Repairs/parts	700	
Operating I:	1	amps(est)	permits/Eng.	2300	
			cops	500	

GROUNDBED DESIGN RESULTS

Resistance:	7.82656	OHMS
Rect. Volts:	7.8	volts
Est. Amps:	1	amps

GROUNDBED COSTS	
Materials:	$797.00
Install:	$12,067.00
Total	$12,864.00

DRILLING DEPTH 15 FEET

0.2281403 VOLTAGE GRADIENT AT PIPE

1 GROUND BED CURENT IN AMPS
25000 RES. OHMS/CM.
110 LENGTH ANODE IN FEET
200 DISTANCE ANODE TO PIPE OR ?

Summary report - written alternative analysis for Wetland File Number 207-448 Fuller Street, Ludlow, MA alternate site possibilities and purchasing alternative land rights.

Part 1 Bay state Gas Co. a division of Nisource summary of alternate site reviews along our existing 16" High Pressure Line From Worcester street in Springfield to Miller Street in Ludlow.

Part 2 Partial report from CC Technologies stating need for and new impressed current CP system.

Detailed plans of our faculties and reports will not be part of this report due to our pipe line security, Home Land Security, and our own company policy of need to know.

IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM DESIGN PARAMETERS

- **Maximum use to protect gas lines**
- **Minimum interference to other structures**
- **Minimum impact to the environment.**
- **Electric service near or accessible.**
- **Low cost area if possible.**
- **Check multiple sites for viability.**
- **Low impact to other pipelines in area.**
- **SOIL RESISTANCE FOR GROUND BED:**
  1. **LESS THAN 500** Ohm – Centimeters **EXCELLENT AREA**
  2. **500** Ohm – Centimeters to **5,000** Ohm – Centimeters **GOOD AREA**
  3. **5,000** Ohm – Centimeters **to 10,000** Ohm – Centimeters **FAIR AREA**
  4. **10,000** Ohm – Centimeters **to 25,000** Ohm – Centimeters **POOR AREA**
  5. **25,000** Ohm – Centimeters **to 50,000** Ohm – Centimeters **VERY POOR AREA**
  6. **50,000** Ohm – Centimeters **AND MORE NOT ACCEPTABLE FOR GROUND BED DESIGN**

- **Must protect the 16" High Pressure Line from Worchester Street in Springfield to Miller Street in Ludlow at the Massachusetts Turnpike Overhead crossing.**

- **Any area with soil resistance over 25,000 Ohm – Centimeters will not be consider a viable site due to high voltage requirements, high cost evolved in installing a ground bed, their ability to achieve current output outputs to protect the existing line is almost improbable and the interference problems it may generate.**

SITE #1
Springfield Worcester St.

1. Soil resistance over 100,000 Ohm – Centimeters
2. Interference to electric and other lines
3. Will not protest line on West St and beyond to Miller St

- Not acceptable site

SITE #2
Ludlow West St.

1. Soil resistance over 58,000 Ohm – Centimeters
2. Interference with our own 6" line
3. Interference with Jet Line
4. Interference with other structures
5. Will not protect our line past Fuller St
6. Too much congestion in the street

- Not acceptable site

SITE #3
Ludlow West Av.

- Soil resistance over 70,000 Ohm – Centimeters
- Interference with our own 6" line
- Interference with Mobile Line
- Interference with other structures
- Will not protect past Fuller St
- Not acceptable site

SITE #4
Ludlow Chicopee River near bridge

1. Soil resistance 22,000 to 30,000 Ohm – Centimeters
2. Need 450 feet or more of river bottom wetland impact over 600 lineal feet
3. Interference with Jet line and Mobile ground beds and line
4. Mobile has a ground bed in the river
5. Will not protect line after Chapin St.

- Not acceptable site

SITE #5
Ludlow : Godou St., Lillian St., Florida Dr., Ronald Rd., Dover Rd And Davis St.

1. Soil resistance over 100,000 Ohm – Centimeters
2. Interference with our own 6" line
3. Interference with Mobile Line
4. Interference with other structures
5. Will not protect past Chapin St.

- Not acceptable site

SITE #6
Ludlow : North area on Massachusetts Turnpike by pond near West St.

1. Soil resistance range is 25,000 to 28,000 Ohm – Centimeters
2. Mobile has ground bed in it cannot use this area due to interference with their Pipe line and Ground bed
3. Will not protect the line in Ludlow
4. Will not protect full length of line in Ludlow

- Not acceptable site

SITE #7
Ludlow : North area on Massachusetts Turnpike from West Av to 700 feet past East Street

1. Conflict with Mobile Line
2. Interference with our own line
3. Soil resistance very high in most places over 50,000 Ohm – Centimeters
4. Will not protect line

- Not acceptable site

SITE #8

Ludlow : South area on Massachusetts Turnpike from West Av to Miller Street not the wetland areas

1. Soil resistance grader than 50,000 ohm – centimeters
2. No useable power source within 500 feet
3. Costly connections to our 16" line
4. Not practical locations because the ground beds will not work

- Not acceptable site

SITE #9

Ludlow : Wood Pond

1. Soil resistance 20,000 to 50,000 ohm – centimeters
2. No useable power source within 500 feet
3. Need 1000 feet lineal feet of wetland and pond
4. Will not protect full length of line in Ludlow

- Not acceptable site

SITE #10

Ludlow : wetland type area between White St. and Prospect St.

1. Soil resistance 25,000 to 50,000 ohm – centimeters
2. No useable power source within 500 feet
3. Need 1090 feet lineal feet of wetland and pond
4. Will not protect full length of line in Ludlow

- Not acceptable site

SITE #11

Ludlow : Chapin St.

1. Soil resistance over 100,000 Ohm – Centimeters
2. Interference with MMWEC 20" LINE
3. Interference with Mobile Line
4. Interference with other structures
5. Will not protect past Chapin St. 200 feet in each direction

- Not acceptable site

SITE #12

Ludlow : Miller St.

1. Soil resistance over 100,000 Ohm – Centimeters and LEDGE
2. Interference with BSG 12"
3. Interference with water lines
4. Interference with other structures
5. Interference with the LNG Plant
6. Will not protect past Chapin St.

- Not acceptable

SITE #13

Ludlow : Miller St. at Green Town Bridge and in Chicopee River

1. Soil resistance over 22,000 to 100,000 Ohm – Centimeters
2. Interference with BSG 12"
3. Interference with water lines
4. Interference with other structures
5. Interference with the LNG Plant
6. Will not protect past Chapin St.
7. Interference with existing ground beds in the Chicopee River

- Not acceptable site

SITE #14

Ludlow : Waz St.

1. Soil resistance over 42,000 to 100,000 Ohm – Centimeters
2. Interference with BSG 6" and 4" lines
3. Interference with water lines
4. Interference with other structures
5. Interference with the 16" line we are trying to protect.
6. Area too small for a 600 foot ground bed
7. Will not protect full length of line in Ludlow

- Not acceptable site

SITE #15

Ludlow : Fuller St.

1. Soil resistance 16,000 to 19,000 Ohm – Centimeters area as shown on plan Exhibit A-1 where the anodes are planed to be placed
2. Minimum interference to structures
3. Soil resistance over 52,000 to 100,000 Ohm – Centimeters at toe of slope to the paving area (only useable area is parallel to south fence on Turnpike Property about 20 to 30 feet wide.)
4. Power source across the street
5. Less than 80 feet linear in wetland
6. Will protect 16" High Pressure Gas Line from Worcester St. Springfield to Miller St, Ludlow
7. Will protect other 6" gas line on Fuller Street

- Acceptable site

SITE #16

Ludlow : wetland area near Bramucci St. and west of Chapin St. and near King St. area

1. Areas too small
2. Will not protect gas line
3. Not a good site to install Cathodic Protection System

- Not acceptable site

SITE #17

Ludlow : wetland area south side of Massachusetts Turnpike starting at Center street going west to intermittent drainage brook

1. Soil resistance 19,000 to 35,000 Ohm - Centimeter
2. Interference on Mobile Pipe Line
3. 400 to 500 linear foot possible wetland encroachment
4. Will not protect our 16" line
5. Conflict with our own gas lines in Center St.
6. Interference with other structures
7. Will not protect full length of line in Ludlow

- Not acceptable site

Conclusions:

1. **The area from Worcester Street in Springfield to and Miller Street Ludlow to Boston Road Wilbraham was examined for possible ground bed sites and the only site that will work for protection the 16" High-Pressure line is at Fuller Street on the south side of the Massachusetts Turnpike area.**
2. **The 16" High pressure pipe line was walked several times from Mass Power Electric Plant in Springfield to Miller Street end at the Ludlow Town line evaluating possible and practical ground bed sites and site number 15 Fuller Street is the best site to protect the line from Worcester Street Springfield to Miller Street Ludlow.**
3. **In this summery review of sites study for impressed current CP systems; Location 15 is the only viable and usable site that can protect this line without massive interference problems to other utilities, protect the whole line in Ludlow. The only drawback is that it is on Massachusetts Turnpike property and the soil resistance is only a poor to fair choice.**
4. **Most of the land sites parallel to our line have very high soil resistance, which**

automatically makes them a non-usable site for a CP system that will last and perform to meet our requirements of protecting our line.

5. **Site # 15 has a very small to work area to install anodes in which is approximitly twenty to thirty feet wide along the southerly fence of the Mass. Pike for about 350 feet long.**
6. **Obtain a right of way on Massachusetts Turnpike Land**
7. **Any ground bed site along the Massachusetts Turnpike which is closer than 100 feet to our pipeline will cause interference problems to our own line and Mobiles Line; also our line for the most part in Ludlow is in high resistance soil.**
8. **No other site will provide adequate protection of our existing gas line at a lesser impact to other utilities and wetland areas other than Fuller Street / Turnpike area site number 15 see plan in NOI**

Part 1 Bay state Gas Co. a division of Nisource summary of alternate site reviews along our existing 16" High Pressure Line From Worcester street in Springfield to Miller Street in Ludlow.

Part 2 Partial report from CC Technologies stating need for and new impressed current CP system and location of said system.

SOIL RESISTIVITY SURVEY & LAYER VALUE DETERMINATION

TOWN So. Hadley LOCATION Lathrop St @ Alvord DATE 3-5-92 TESTER [illegible]

4 PIN DATA					LAYER PROCEDURE				LAYER RESISTIVITY	
Location No.	Spacing Feet	R ' ohms	Factor X	Resistivity ohm - Cm.	1 / R ' Mhos	Δ 1 / R ' Mhos	R ² 1 / Δ 1 / R ' Mhos	Factor X	R ³ ohm - Cm.	Layer Depth Feet
	2' - 7"	—	500	—	—	—	—	500	—	0 - 2'7"
	5' - 3"	25	1000	25,000	.040	.04	25.00	500	12,500	2'7" - 5'3"
	7' - 10"	14	1500	21,000	.071	.031	32.258	500	16,129	5'3" - 7'10"
	10' - 6"	7	2000	4,000	.143	.072	13.88	500	6,940	7'10" - 10'6"
	13' - 1"	5.2	2500	13,000	.192	.049	20.408	500	10,204	10'6" - 13'1"
	15' - 8"	4.3	3000	12,900	.233	.041	24.39	500	12,195	13'1" - 15'8"
	18' - 3"	3.8	3500	13,300	.263	.030	33.33	500	16,665	15'8" - 18'3"
	20' - 10"	3.25	4000	13,000	.307	.044	22.727	500	11 363	18'3" - 20'10"
	23' - 6"	2.85	4500	12,825	.351	.044	22.727	500	11, 363	20'10" - 23' 6"
	26' - 1"	2.4	5000	12,000	.412	.061	16.393	500	8,196	23'6" - 26'1"
	2' - 7"		500					500		0 - 2'7"
	5' - 3"	6.9	1000	6,900	0.145	.145	14.5	500	6,900	2'7" - 5'3"
	7' - 10"		1500					500		5'3" - 7'10"
	10' - 6"		2000					500		7'10" - 10'6"
	13' - 1"		2500					500		10'6" - 13'1"
	15' - 8"	2.6	3000	7,8000	.385	—	—	500	10, 416	13'1" - 15'8"
	18' - 3"		3500					500		15'8" - 18'3"
	20' - 10"		4000					500		18'3" - 20'10"
	23' - 6"		4500					500		20'10" - 23' 6"
	26' - 1"		5000					500		23'6" - 26'1"

SOIL RESISTIVITY SURVEY & LAYER VALUE DETERMINATION

TOWN: SPRINGFIELD LOCATION: 2268 WILB. RD DATE: 11/24/96 TESTER: KS

	4 PIN DATA					LAYER PROCEDURE						
LOCATION NO.	SPACING FEET	R1 OHMS	FACTOR X	RESISTIVITY OHM-CM	1/R1 MHOS	d1/R1 MHOS	R2 1/d1/R1 MHOS	FACTOR X	LAYER R3 OHM-CM	RESISTIVITY LAYER DEPTH FEET	
	2'- 7"	200	500	100000	0.0050		200.0000	500	100000	0-2'7"	
	5'- 3"	250	1000	250000	0.0040	-0.0010	#########	500	-500000	2'7"-5'3"	
	7'-10"	220	1500	330000	0.0045	0.0005	1833.3333	500	916667	5'3"-7'10"	
	10'-6"	190	2000	380000	0.0053	0.0007	1393.3333	500	696667	7'10"-10'6"	
	13'-1"	150	2500	375000	0.0067	0.0014	712.5000	500	356250	10'6"-13'1"	
	15'-8"	78	3000	234000	0.0128	0.0062	162.5000	500	81250	13'1"-15'8"	
	18'-3"	58	3500	203000	0.0172	0.0044	226.2000	500	113100	15'8"-18'3"	
	20'-10"	38	4000	152000	0.0263	0.0091	110.2000	500	55100	18'3"-20'10"	
	23'-6"	31	4500	139500	0.0323	0.0059	168.2857	500	84143	20'10"-23'6"	
	26'-1"	28	5000	140000	0.0357	0.0035	289.3333	500	144667	23'6"-26'1"	
	28'-9"	20	5500	110000	0.0500	0.0143	70.0000	500	35000	26'1"-28'9"	

IMPRESSED CURRENT GROUNDBED DESIGN
BRECKWOOD CIR

IMPRESSP.WK4

Resistivity: 10000 ohm-cm

MATERIAL COST

Anode Type:			Anode:	175	ea.
Anode Dia:	3	in.	Anode Cbl:	0.1	$/ft
Anode Length:	96	in.	Hdr Cbl:	1.25	$/ft
# of Anodes:	10		Splice:	25	
Anode Spcng	25	ft.			
Dist. Remote	335	ft.			

INSTALLATION COSTS

Trenching:	4.4	$/ft
Anode Inst:	252	per anode
Splc Inst:	15	per splice
Power Cost:	0.1	$/kwh
Electric	1000	
Rectifier	1100	
Repairs/parts	700	
permits/Eng.	1000	
cops	0	

SIZE

Hdr Cable: 0 AWG

Header length 1170

Operating I: 16 amps(est)

GROUNDBED DESIGN RESULTS

Resistance:	3.84870	OHMS
Rect. Volts:	61.6	volts
Est. Amps:	16	amps

GROUNDBED COSTS

Materials:	$4,450.00
Install:	$13,408.00
Total	$17,858.00

DRILLING DEPTH 21 FEET

0.8350204 VOLTAGE GRADIENT AT PIPE

16 GROUND BED CURENT IN AMPS
10000 RES. OHMS/CM.
80 LENGTH ANODE IN FEET
400 DISTANCE ANODE TO PIPE OR ?

IMPRESSED CURRENT GROUNDBED DESIGN

SOILRESP.W K4

Resistivity: 25000 ohm-cm

MATERIAL COST

Anode Type:		Anode:	175	ea.
Anode Dia:	3 in.	Anode Cbl:	0.1	$/ft
Anode Length:	120 in.	Hdr Cbl:	1.25	$/ft
# of Anodes:	15	Splice:	25	
Anode Spcng	30 ft.	INSTALLATION COSTS		
Dist. Remote	200 ft.	Trenching:	4.4	$/ft
		Anode Inst:	252	per anode
	SIZE	Splc Inst:	15	per splice
Hdr Cable:	6 AWG	Power Cost:	0.1	$/kwh
		Electric	1000	
Header length	1300	Rectifier	1100	
		Repairs/parts	700	
Operating I:	16 amps(est)	permits/Eng.	1000	
		cops	0	

GROUNDBED DESIGN RESULTS

Resistance:	5.55317 OHMS	GROUNDBED COSTS	
Rect. Volts:	88.9 volts	Materials:	$6,400.00
Est. Amps:	16 amps	Install:	$14,435.00
		Total	$20,835.00
		DRILLING DEPTH	21

0.8091775 VOLTAGE GRADIENT AT PIPE
5 GROUND BED CURENT IN AMPS
25000 RES. OHMS/CM.
150 LENGTH ANODE IN FEET
200 DISTANCE ANODE TO PIPE OR ?

CABLE RESISTANCE TABLE

size	resist
0	#
1	#
2	#
3	#
4	#
5	#
6	#
7	#
8	#
9	#
12	#
16	#

8.4

3.03

SOIL RESITIVITY AND LAYER VALUE DE VA LUE DETER M INATION

LOCATION: Wilbraham Rd SP DATE: TESTER:GUS/KES 11-30-98

	4 PIN DAT A						LAYER	PROCEDURE		
SPACING FEET	R1 OHMS	FACTOR X	RESISTIVIT OHM-CM	1/R1 MHOS	d1/R1 MHOS	R2 1/d1/R1 MHOS	FACTOR X	LAYER R R3 OHM-CM	E SISTIVITY LAYER DEI FEET
5	450	957.5	430875	0.0022		450.0000	957.5	430875	0-5
10	85	1915	162775	0.0118	0.0095	104.7945	957.5	100341	5-10
15	12	2872.5	34470	0.0833	0.0716	13.9726	957.5	13379	10-15
25	9	4787.5	43087.5	0.1111	0.0278	36.0000	1915	68940	15-25
30	0.01	5745	57.45	100.0000	99.8889	0.0100	957.5	10	25-30
35	0.01	6702.5	67.025	100.0000	0.0000	#DIV/0!	957.5	#DIV/0!	30-35
40	0.01	7660	76.6	100.0000	0.0000	#DIV/0!	957.5	#DIV/0!	35-40
45	0.01	8617.5	86.175	100.0000	0.0000	#DIV/0!	957.5	#DIV/0!	40-45
50	0.01	9575	95.75	100.0000	0.0000	#DIV/0!	957.5	#DIV/0!	45-50

S OIL RESIS T IVITY SUR V EY & LAYER VA LUE DETEF M INATION

TOWN: SPRINGFIELD LOCATION: 2268 WILB. RD DATE: 11/24/96 TESTER: KS

		4 PIN DAT A						LAYER	PROCEDURE	
LOCATION NO.	SPACING FEET	R1 OHMS	FACTOR X	RESISTIVITY OHM-CM	1/R1 MHOS	d1/R1 MHOS	R2 1/d1/R1 MHOS	FACTOR X	LAYER R R3 OHM-CM	E
	2'- 7"	200	500	100000	0.0050		200.0000	500	100000	
	5'- 3"	250	1000	250000	0.0040	-0.0010	#########	500	-500000	
	7'-10"	220	1500	330000	0.0045	0.0005	1833.3333	500	916667	
	10'-6"	190	2000	380000	0.0053	0.0007	1393.3333	500	696667	
	13'-1"	150	2500	375000	0.0067	0.0014	712.5000	500	356250	
	15'-8"	78	3000	234000	0.0128	0.0062	162.5000	500	81250	
	18'-3"	58	3500	203000	0.0172	0.0044	226.2000	500	113100	
	20'-10"	38	4000	152000	0.0263	0.0091	110.2000	500	55100	
	23'-6"	31	4500	139500	0.0323	0.0059	168.2857	500	84143	
	26'-1"	28	5000	140000	0.0357	0.0035	289.3333	500	144667	
	28'-9"	20	5500	120000	0.0500	0.0143	70.0000	500	35000	

SISTIVITY LAYER DEPTH FEET
0-2'7"
2'7"-5'3"
5'3"-7'10"
7'10"-10'6"
10'6"-13'1"
13'1"-15'8"
15'8"-18'3"
18'3"-20'10"
20'10"-23'6"
23'6"-26'1"
26'1"-28'9"

IMPRESSED CURRENT GROUNDBED DESIGN FOR MORE THAN ONE ANODE
410 WILLIAMS ST. WILLIAMS MIDDLE SCHOOL, LONGMEADOW

Resistivity: 14000 ohm-cm

							TOTAL COST	
			MATERIAL COST					
Anode Type:			Anode:	175	ea.		$250.00	IN STOCK
Anode Dia:	3	in.	Anode Cbl:	0.1	$/ft		$32.00	IN STOCK
Anode Length:	120	in.	Hdr Cbl:	1	$/ft		$225.00	
			RECTIFIER	1100			$1,100.00	
# of Anodes:	16		Splice:	15			$400.00	
Anode Spcng	15	ft.	INSTALLATION COSTS					
Dist. Remote	100	ft.	Trenching:	$4.50	$/ft		$1,012.50	*
			Anode Inst:	$300.00	per anode		$4,800.00	*
	SIZE		Splc Inst:	$25.00	per splice		$425.00	
Hdr Cable:	1	AWG	Power Cost:	$0.10	$/kwh			
			Electric	$850.00			$850.00	*
			Rectifier	$1,000.00			$1,000.00	*
Operating I:	16	amps(est)	Conservation	$0.00			$1,200.00	*
			PERMITS	$500.00			$500.00	*
			COPS	$0.00			$350.00	

GROUNDBED DESIGN RESULTS

Resistance:	4.77431	OHMS	GROUNDBED COSTS		
Rect. Volts:	76.4	volts	Materials:	$8,165.00	
Est. Amps:	10	amps	Install:	$4,912.50	
			Total	$14,577.50	$12,144.50

Header length 225

DRILLING DEPTH **50 FEET**

S OIL RESIS T IVITY SUR V EY & LAYER VA LUE DETEF M INATION

TOWN: Springfield LOCATION: LIBERTY ST. DATE: 03/26/91 TESTER: KS/GS/BC/AC

		4 PIN DAT A					LAYER PROCEDURE				
LOCATION NO.	SPACING FEET	R1 OHMS	FACTOR X	RESISTIVITY OHM-CM	1/R1 MHOS	d1/R1 MHOS	R2 1/d1/R1 MHOS	FACTOR X	LAYER R E R3 OHM-CM	SISTIVITY LAYER DEPTH FEET	
	5'- 3"	65	1000	65000	0.0154		65.0000	1000	65000	0'0"-5'3"	
	10'-6"	16	2000	32000	0.0625	0.0471	21.2245	1000	21224	5'3"-10'6"	
	15'-8"	8.4	3000	25200	0.1190	0.0565	17.6842	1000	17684	10'6"-15'8"	
	20'-10"	2.1	4000	8400	0.4762	0.3571	2.8000	1000	2800	15'8"-20'10"	
	26'-1"	1.1	5000	5500	0.9091	0.4329	2.3100	1000	2310	20'10"-26'1"	
	31'-3"	0.8	6000	4800	1.2500	0.3409	2.9333	1000	2933	26'1"-31'3"	

IMPRESSED CURRENT GROUNDBED DESIGN

Eastfield Mall

EASTFIELD_MALL_GROUND BED

Resistivity: 12000 ohm-cm

MATERIAL COST

Anode Type:			Anode:	175	ea.
Anode Dia:	2.75	in.	Anode Cbl:	0.1	$/ft
Anode Length:	120	in.	Hdr Cbl:	1.25	$/ft
# of Anodes:	15		Splice:	20	
Anode Spcng	25	ft.	**INSTALLATION COSTS**		
Dist. Remote	1000	ft.	Trenching:	4.4	$/ft
			Anode Inst:	252	per anode
SIZE			Splc Inst:	16	per splice
Hdr Cable:	0	AWG	Power Cost:	0.1	$/kwh
			Electric	1000	
Header length	2750		Rectifier	1300	
			Repairs/parts	700	
Operating I:	8	amps(est)	permits/Eng.	1000	
			cops	500	

GROUNDBED DESIGN RESULTS

Resistance:	3.36987	OHMS
Rect. Volts:	27	volts
Est. Amps:	8	amps

GROUNDBED COSTS

Materials:	$ 7,237.50
Install:	$ 25,052.00
Total	$ 32,289.50

DRILLING DEPTH 25 FEET

0.1339848 VOLTAGE GRADIENT AT PIPE

8 GROUND BED CURENT IN AMPS
12000 RES. OHMS/CM.
150 LENGTH ANODE IN FEET
1000 DISTANCE ANODE TO PIPE OR ?

IMPRESSED CURRENT GROUNDBED DESIGN
EASTFIELD MALL SPRINGFIELD

soilmall

Resistivity: 30000 ohm-cm

MATERIAL COST

Anode Type:		Anode:	175	ea.	
Anode Dia:	3 in.	Anode Cbl:	0.1	$/ft	
Anode Length:	120 in.	Hdr Cbl:	1.25	$/ft	
# of Anodes:	15	Splice:	25		
Anode Spcng	25 ft.	INSTALLATION COSTS			
Dist. Remote	1500 ft.	Trenching:	4.4	$/ft	
		Anode Inst:	252	per anode	8.4
SIZE		Splc Inst:	15	per splice	
Hdr Cable:	0 AWG	Power Cost:	0.1	$/kwh	
		Electric	1000		
Header length	3750	Rectifier	1100		
		Repairs/parts	700		
Operating I:	6 amps(est)	permits/Eng.	1000		
		cops	0		

GROUNDBED DESIGN RESULTS

Resistance:	6.99006 OHMS	GROUNDBED COSTS	
Rect. Volts:	41.9 volts	Materials:	$7,937.50
Est. Amps:	6 amps	Install:	$25,303.00
		Total	$33,240.50
		DRILLING DEPTH	21

#VALUE! VOLTAGE GRADIENT AT PIPE #VALUE!

18 GROUND BED CURENT IN AMPS
19000 RES. OHMS/CM.
220 DISTANCE ANODE TO PIPE OR ?

CABLE RESISTANCE TABLE

size	resist
0	#
1	#
2	#
3	#
4	#
5	#
6	#
7	#
8	#
9	#
12	#
16	#

SOIL RESITIVITY AND LAYER VALUE DE V LUE DETE MINATION

LOCATION: DATE: TESTER:

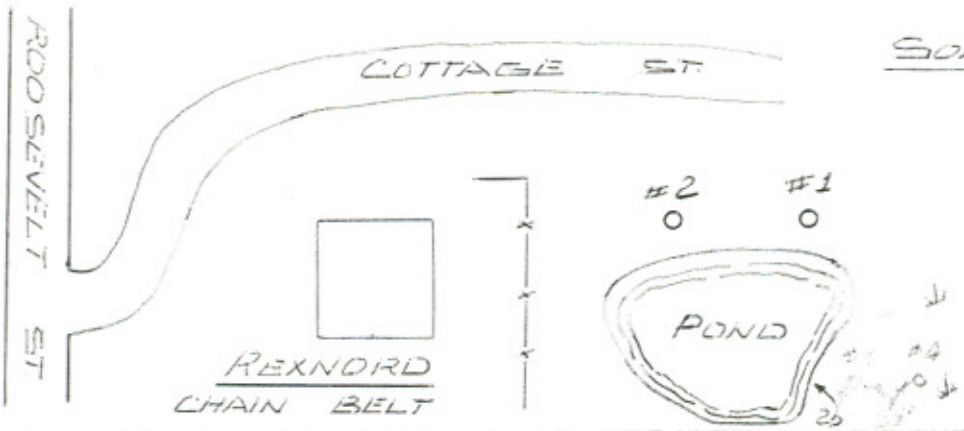
	4 PIN DAT A							LAYER	PROCEDURE		
SPACING FEET	R1 OHMS	FACTOR X	RESISTIVITY OHM-CM	1/R1 MHOS	d1/R1 MHOS	R2 1/d1/R1 MHOS	FACTOR X	LAYER R3 OHM-CM	E SISTIVITY LAYER DEI FEET	
10	66	1915	126390	0.0152	0.0152	66.0000	1915	126390	0-10	
15	22	2872.5	63195	0.0455	0.0303	33.0000	957.5	31598	10-15	
20	20	3830	76600	0.0500	0.0045	220.0000	957.5	210650	15-20	
25	42	4787.5	201075	0.0238	-0.0262	-38.1818	957.5	-36559	20-25	
30	52	5745	298740	0.0192	-0.0046	-218.4000	957.5	-209118	25-30	
40	320	7660	2451200	0.0031	-0.0161	-62.0896	1915	-118901	30-40	
50	240	9575	2298000	0.0042	0.0010	960.0000	1915	1838400	40-50	
							-9575			

BAY STATE GAS CO.

CORROSION & ANALYSIS DEPT.
CORROSION ANALYSIS SURVEY

LINE _____ LOCATION Cottage St., Spfld.

DATE 8-3-76 TESTERS H. EVERETT W. AINEY



Soil Resistivity Tests

Loc	Pin Spacing Ft.	Mtr Rdg Ω	X	Rs Ω/cm
#1	2'-6"	140	500	70,000
	5'-2"	32	1000	32,000
	7'-8"	20	1500	30,000
	10'-4"	14	2000	28,000
	13'-0"	10	2500	25,000
	15'-6"	9.5	3000	28,500
#2				
	2.6"	76	500	38,000
	5'-2"	32	1000	32,000
	7'-8"	18	1500	27,000
	10'-4"	12	2000	24,000
	13'-0"	10	2500	25,000
	15'-6"	9	3000	27,000
#3				
	2'-6"	29	500	14,500
	5'-2"	14	1000	14,000
	7'-8"	8.5	1500	12,750
	10'-4"	5.7	2000	11,400
	13'-0"	5.0	2500	12,500
	15'-6"	4.4	3000	13,200
#4				
	2'-6"	22	500	11,000
	5'-2"	14	1000	14,000
	7'-8"	7	1500	10,500
	10'-4"	6	2000	12,000
	13'-0"	5.3	2500	13,250
	15'-6"	4.6	3000	13,800

DISTRICT SPFLD / H. EVERETT LOCATION COTTAGE ST. DATE 8-3-76

TESTERS W. AINEY

PIN SPACING FT.	RES. OHMS	1/RES MHOS	Δ 1/RES. MHOS	Δ RES. OHM	X FACTOR	LAYER RES OHM/CM	LAYER FT.
Loc. #1							
2'-6"	140	0.007	—	140	500	70,000	0 — 2'-6"
5'-2"	32	0.031	0.024	41.7	500	20,850	2'-6" — 5'-2"
7'-8"	20	0.050	0.019	52.6	500	26,300	5'-2" — 7'-8"
10'-4"	14	0.070	0.020	50.0	500	25,000	7'-8" — 10'-4"
13'-0	10	0.100	0.03	33.3	500	16,650	10'-4" — 13'-0"
15'-6"	9.5	0.105	0.005	200	500	100,000	13'-0" — 15'-6"
Loc. #2							
2'-6"	76	0.013	—	76	500	38,000	0 — 2'-6"
5'-2"	32	0.031	0.018	55.5	500	27,750	2'-6" — 5'-2"
7'-8"	18	0.056	0.025	40.0	500	20,000	5'-2" — 7'-8"
10'-4"	12	0.083	0.027	37.0	500	18,500	7'-8" — 10'-4"
13'-0"	10	0.100	0.017	58.8	500	29,400	10'-4" — 13'-0
15'-6"	9	0.111	0.011	90.9	500	45,450	13'-0 — 15'-6"

DISTRICT Spfld LOCATION Cottage St. DATE 8-3-76 SHEET NO. 3

TESTERS H.E. & W.A.

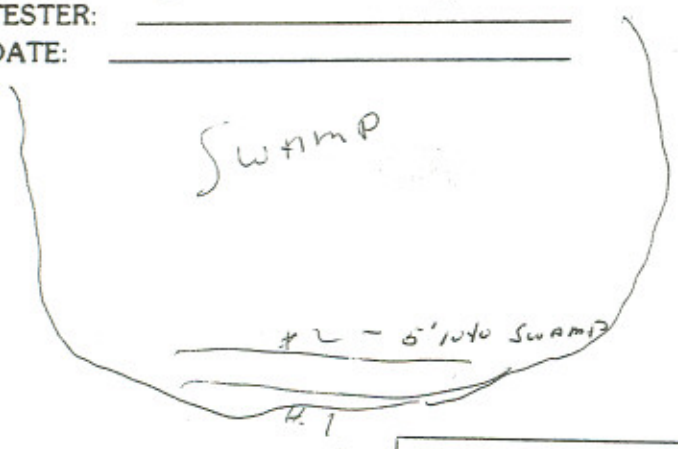
PIN SPACING FT.	RES. OHMS	1/RES MHOS	Δ 1/RES. MHOS	Δ RES. OHM	X FACTOR	LAYER RES OHM/CM	LAYER FT.
Loc. #3							
2'-6"	29	0.034	—	29	500	14,500	0 - 2'-6"
5'-2"	14	0.071	0.037	27	500	13,500	2'-6" — 5'-2
7'-8"	8.5	0.118	0.047	21.3	500	10,650	5'-2" — 7'-8
10'-4"	5.7	0.175	0.057	17.5	500	8,750	7'-8" — 10'-4
13'-0"	5.0	0.200	0.025	40	500	20,000	10'-4" — 13'-0
15'-6"	4.4	0.227	0.027	37	500	18,500	13'-0 — 15'-6
Loc #4							
2'-6"	22	0.045	—	22	500	11,000	0 - 2'-6"
5'-2"	14	0.071	0.026	38.5	500	19,250	2'-6" — 5'-2
7'-8"	7	0.143	0.072	13.9	500	6,950	5'-2" — 7'-8
10'-4"	6	0.167	0.024	42	500	21,000	7'-8" — 10'-4
13'-0"	5.3	0.189	0.022	45.5	500	22,750	10'-4" — 13'-0
15'-6"	4.6	0.217	0.028	35.7	500	17,850	13'-0 — 15'-6

Bay State Gas

Bay State Gas Company
D.T.E. 05-27
Attachment AG-14-23(x)
Page 1 of 2

CORROSION CONTROL SURVEY

TOWN: SPFD
LINE: BIG D PLAZA
TESTER:
DATE:



REAR BIG D PLAZA
LOC. #

	FACTOR	READING	X	=					
2'-7"	10	.84	500	4200	2.7	10	.50		
5'-2"	10	.55	1000	5500	5.2	10	.55		
7'-9"	10	.48	1500	7200	7'5	10	.46		
10'-4"	10	.40	2000	8000	10.	10	.41		
12'-11"	10	.38	2500	9500					
15' 6"									

SOIL RESISTIVITY SURVEY & LAYER VALUE DETERMINATION

TOWN SPELD LOCATION REAR BIG 'D' PLAZA DATE 7/19/84 TESTER GS KS

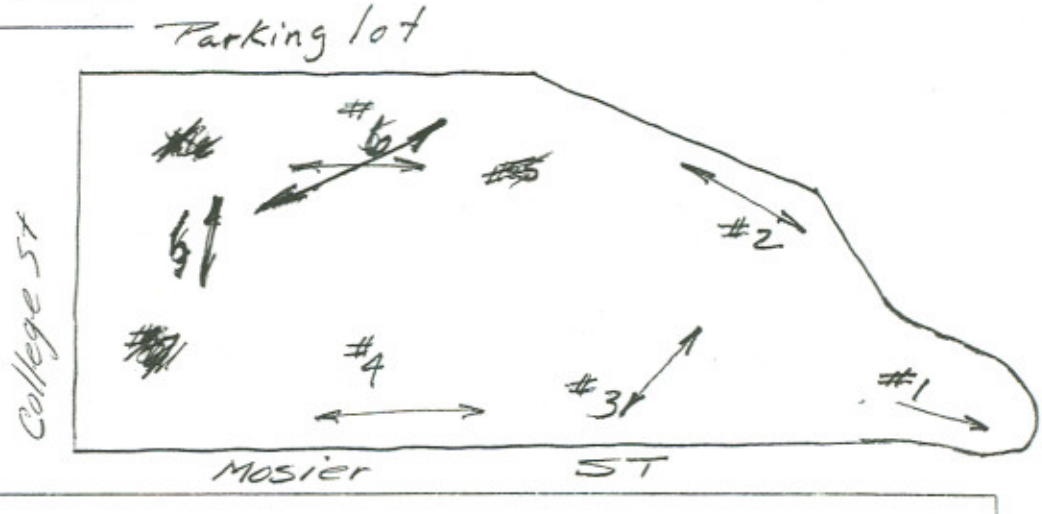
4 PIN DATA					LAYER PROCEDURE					
									LAYER RESISTIVITY	
Location No.	Spacing Feet	R_1 ohms	Factor X	Resistivity ohm-Cm.	$1/R_1$ Mhos	$\Delta 1/R_1$ Mhos	R_2 $1/\Delta 1/R_1$ Mhos	Factor X	R_3 ohm-Cm.	Layer Depth Feet
#1	2'-7"	8.40	500	4200	.119	—	8.4	500	4200	0 to 2'-7"
	5'-2"	5.50	1000	5500	.182	.063	15.9	~~1000~~ 500	~~5,500~~ 7936	2'-7" - 5'-2"
	7'-9"	4.80	1500	7,200	.208	.026	38.5	~~1500~~ 500	~~39,250~~ 19,230	5'-2 to 7'-9
	10'-4"	4.00	2000	8,000	.250	.042	23.8	~~2000~~ 500	~~47,600~~ 12,136	7'-9 to 10'-4"
	12'-11"	3.50	2500	9,500	.263	.013	76.9	~~2500~~ 500	~~32,250~~ 38,461	
#2	2'-7"	9.0	500	4,500	.111	—	9.0	500	4500	— 0-2'-7"
	5'-2"	5.5	1000	5,500	.182	.071	14.1	~~1000~~ 500	~~14,100~~ 7,060	— 2'-7" - 5'-2"
	7'-9"	4.6	1500	6,900	.217	.035	28.6	~~1500~~ 500	~~42,900~~ 14,285	— 5'2" - 7'-9"
	10'-4"	4.1	2000	8,200	.244	.027	37.0	~~2000~~ 500	~~74,000~~ 18518	— 7'-9 - 10'-4"

Bay State Gas

Sheet No. 1-

CORROSION CONTROL SURVEY

TOWN: South Hadley
LINE: Mosier @ College Proposed G/B
TESTER: HAE / G.J.S.
DATE: 10-20-80



Site #1	Pin Spacing	Meter reading	Scale	R, ohms	Factor X	Ω-Cm
	2'-7"	0.150	100	15	500	7500
	5'-2"	0.80	10	8	1000	8000
	7'-9"	0.52	10	5.2	1500	10,800
	10'-4"	0.38	10	3.8	2000	7600
	12'-11"	0.32	10	3.2	2500	8000
	15'-6"	—	—	—	3000	—

Site #2	Pin Spacing	Meter reading	Scale	R, Ohms	Factor	Ω-Cm
	2'-7"	0.21	100	21	500	10500
	5'-2"	0.14	100	14	1000	14,000
	7'-9"	0.82	10	8.2	1500	12,300
	10'-4"	0.70	10	7.0	2000	14,000
	12'-11	0.54	10	5.4	2500	13,600
	15'-6"	0.44	10	4.4	3000	13,200

SOIL RESISTIVITY SURVEY & LAYER VALUE DETERMINATION

TOWN So. Hadley LOCATION Mosier & College St's DATE 10-20-2 TESTER HAE G.J.S.

4 PIN DATA					LAYER PROCEDURE					
									LAYER RESISTIVITY	
Location No.	Spacing Feet	R_1 ohms	Factor X	Resistivity ohm-Cm.	$1/R_1$ Mhos	$\Delta 1/R_1$ Mhos	R_2 $1/\Delta 1/R_1$ Mhos	Factor X	R_3 ohm-Cm.	Layer Depth Feet
Site #1	2'-7"	15	500	7500	0.067	—	15	500	7500	0'-0"-2'-7"
	5'-2"	8	1000	8000	0.125	0.058	17.24	500	8620	2'-7"-5'-2"
	7-9"	5.2	1500	7800	0.192	0.067	14.86	500	7430	5'-2"-7'-9"
	10'-4"	3.8	2000	7600	0.263	0.072	14.05	500	7026	7'-9"-10'-4"
	12'-11"	3.2	2500	8000	0.313	0.050	20.20	500	10,000	10'-4"-12'-11
Site #2	2'-7"	21	500	10,500	0.048	—	21	500	10,500	0'-0"-2'-7"
	5'-2"	14	1000	14,000	0.071	0.023	42.68	500	21,340	2'-7"-5'-2"
	7'-9"	8.2	1500	12,300	0.122	0.051	19.63	500	9,800	5'-2"-7'-9"
	10'-4"	7.0	2000	14,000	0.143	0.021	47.95	500	23,900	7'-9"-10'-4
	12'-11"	5.4	2500	13,500	0.185	0.042	23.71	500	11,850	10'-4"-12'-11
	15'-6"	4.4	3000	13,200	0.227	0.042	23.66	500	11,800	12'-11"-15'-6"

SOIL RESISTIVITY SURVEY & LAYER VALUE DETERMINATION

TOWN So. Hadley LOCATION [illegible] DATE 10-20-80 TESTER HAE, G.J.S.

4 PIN DATA					LAYER PROCEDURE					
									LAYER RESISTIVITY	
Location No.	Spacing Feet	R_1 ohms	Factor X	Resistivity ohm-Cm.	$1/R_1$ Mhos	$\Delta 1/R_1$ Mhos	R_2 $1/\Delta 1/R_1$ Mhos	Factor X	R_3 ohm-Cm.	Layer Depth Feet
Site #3	2'-7"	26	500	13,000	0.038	—	26	500	13,000	0'-0" - 2'-7"
	5'-2"	15	1000	15,000	0.067	0.029	34.89	500	17,400	2'-7" - 5'-2"
	7'-9"	8.0	1500	12,000	0.125	0.058	17.25	500	8620	5'-2" - 7'-9"
	10'-4"	5.8	2000	11,600	0.172	0.047	21.09	500	10,550	7'-9 - 10'-4'
	12'-11"	4.5	2500	11,250	0.222	0.050	19.90	500	9950	10'-4' - 12'-11
	15'-6"	3.8	3000	11,400	0.263	0.041	24.30	500	12,150	12'-11 - 15'-6'
Site #4	2'-7"	26	500	13,000	0.038	—	26	500	13,000	0'-0" - 2'-7"
	5'-2"	14	1000	14,000	0.071	0.033	29.91	500	14,950	2'-7" - 5'-2"
	7'-9"	7.0	1500	10,500	0.143	0.072	13.92	500	6950	5'-2" - 7'-9"
	10'-4"	5.3	2000	10,600	0.188	0.045	22.22	500	11,111	7'-9 - 10'-4'
	12'-11"	3.8	2500	9500	0.263	0.075	13.31	500	6650	10'-4" - 12'-11
	15'-6"	3.0	3000	9000	0.333	0.070	14.23	500	7,100	12'-11" - 15'-6'

Bay State Gas

CORROSION CONTROL SURVEY

TOWN: South Hadley
LINE: Mosier @ College Prop. G/B
TESTER: HAE GJS.
DATE: 10-20-80

Site #3	Pin Space	Meter reading	Scale	R, ohms	Factor X	Ω-Cm
	2'-7"	0.26	100	26	500	13000
	5'-2"	0.15	100	15	1000	15000
	7'-9"	0.80	10	8.0	1500	12000
	10'-4"	0.58	10	5.8	2000	11,000
	12'-11"	0.45	10	4.5	2500	11,250
	15'-6"	0.38	10	3.8	3000	11,400

Site #4	Pin Space	Meter reading	Scale	R, ohms	Factor	Ω·Cm
	2-7	0.26	100	26	500	13,000
	5-2	0.14	100	14	1000	14,000
	7-9	0.70	10	7.0	1500	10500
	10-4	0.53	10	5.3	2000	10600
	12'-11	0.38	10	3.8	2500	9,500
	15'-6	0.30	10	3.0	3000	9000

SOIL RESISTIVITY SURVEY & LAYER VALUE DETERMINATION

TOWN So. Hadley LOCATION Mosier @ College St DATE 10-20-00 TESTER HAE GJS.

4 PIN DATA					LAYER PROCEDURE					
									LAYER RESISTIVITY	
Location No.	Spacing Feet	R_1 ohms	Factor X	Resistivity ohm-Cm.	$1/R_1$ Mhos	$\Delta 1/R_1$ Mhos	R_2 $1/\Delta 1/R_1$ Mhos	Factor X	R_3 ohm-Cm.	Layer Depth Feet
Site 5	2-7"	28	500	14,000	0.036	—	28	500	14000	0'-0" 2'-7"
	5'-2"	14	1000	14,000	0.071	0.035	28.23	500	14,100	2'-7"-5'-2"
	7-9"	8.4	1500	12,600	0.119	0.048	20.81	500	10,400	5'-2"-7'-9"
	10'-4"	6.4	2000	12,800	0.156	0.037	26.85	500	13,400	7'-9"-10'-4"
	12'-11"	4.7	2500	11,750	0.213	0.057	17.62	500	8,800	10'-4"-12'-11"
	15'-6"	3.8	3000	11,400	0.263	0.050	19.9	500	9,900	12'-11"-15'-6"
Site #6	2-7"	42	500	21,000	0.024	—	42	500	21,000	0'-0"-2'-7"
	5'-2"	23	1000	23,000	0.044	0.019	51.34	500	25,600	2'-7"-5'-2"
	7'-9"	15	1500	22,500	0.067	0.023	44.12	500	22,000	5'-2"-7'-9"
	10'-4"	7.8	2000	15,600	0.128	0.061	16.34	500	8,100	7'-9"-10'-4"
	12'-11"	5.4	2500	13,500	0.185	0.057	17.49	500	8,750	10'-4"-12'-11"
	15'-6"	4.6	3000	13,800	0.217	0.032	30.87	500	15,400	12'-11"-15'-6"

Bay State Gas

CORROSION CONTROL SURVEY

TOWN: South Hadley
LINE: Mosier Ct College Rep 6/13
TESTER: HAE G.F.S.
DATE: 10-20-80

site #5	Pin Space	Meter reading	Scale	R. ohms	Factor	Ω-Cm
	2'-7	0.28	100	28	500	14,000
	5'-2	0.14	100	14	1000	14,000
	7-9	0.84	10	8.4	1500	12,600
	10'-4	0.64	10	6.4	2000	12800
	12'-11	0.47	10	4.7	2500	11,700
	15'-6"	0.38	10	3.8	3000	11,400

site #6	Pin Space	Meter reading	Scale	R. ohms	Factor	Ω-Cm
	2-7	0.42	100	42	500	21,000
	5-2	0.23	100	23	1000	23,000
	7-9	0.15	100	15	1500	22,500
	10'-4	0.78	10	7.8	2000	15,600
	12'-11	0.54	10	5.4	2500	13,500
	15'-6	0.46	10	4.6	3000	13,800

Bay State Gas

Sheet No. 1

CORROSION CONTROL SURVEY

NET #24

TOWN: WILBRAHAM
LINE: 12" H.P. Outer Belt
TESTER: H.E., G.S., W.A
DATE: 5-10-78

SOIL RESISTIVITY TEST.
TINKHAM RD., WILBRAHAM

SEE SHEET #3 FOR TEST LOCATION

Loc.	Pin Spacing	ohm.	x	Ω/cm					
1	2'-6"	20	500	10,000					
	5'-2"	8	1000	8,000					
	7'-6"	3.5	1500	5,250					
	10'-4"	3.3	2000	6,600					

SHEET N = 6

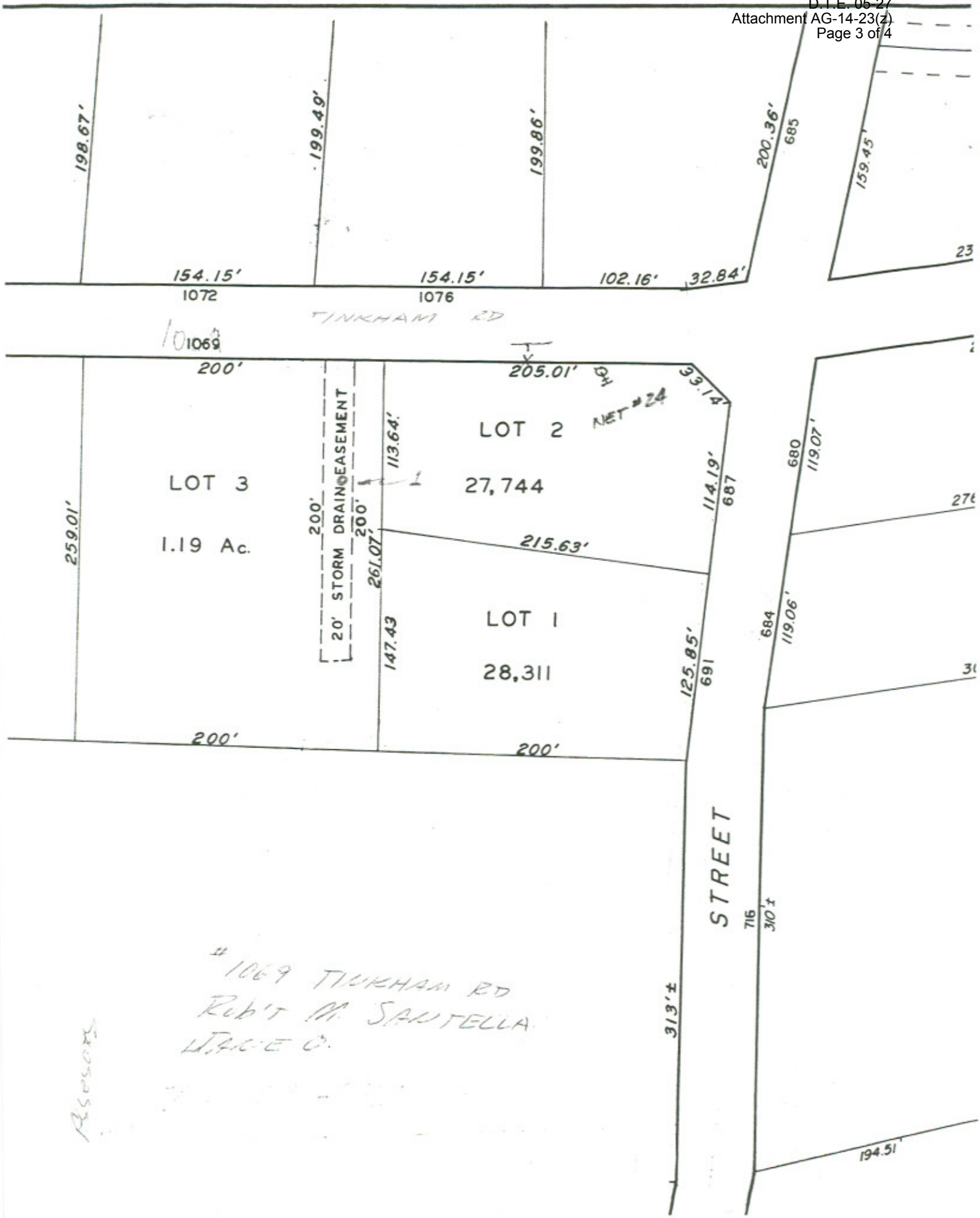
DISTRICT E. PELD. LOCATION TINKHAM RD @ MAIN ST. DATE 5-16-78

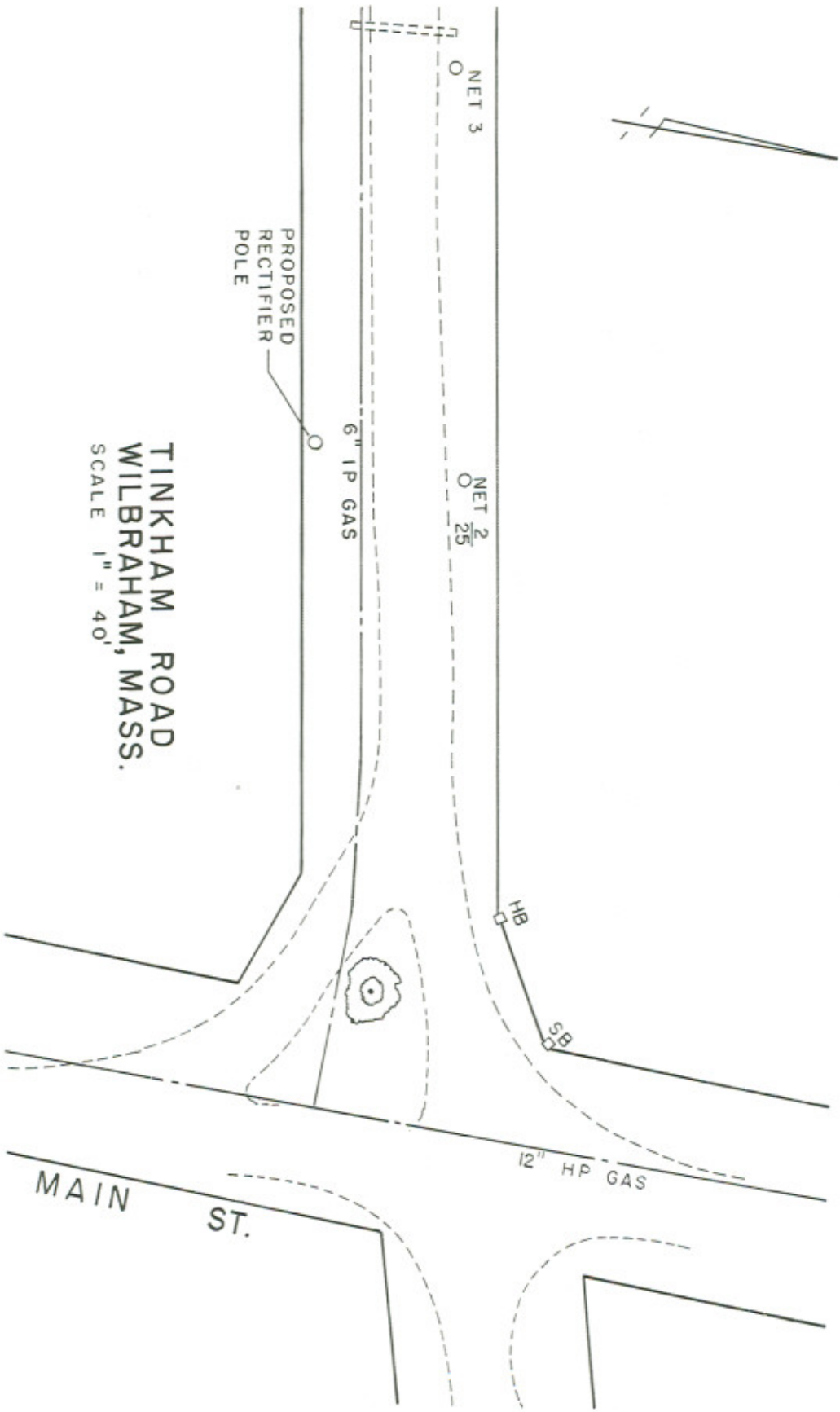
TESTERS H.E., G.S. & W.A.

IN SPACING	RES. OHMS	1/RES MHOS	Δ 1/RES. MHOS	Δ RES. OHM	X FACTOR	LAYER RES OHM/CM	LAYER FT.
2'-6"	20	0.05	—	20	500	10,000	0 — 2-6"
5'-2"	8	0.125	0.075	13	500	6,500	2'-6" — 5'-2"
7'-6"	3.5	0.285	0.160	6.22	500	3,110.	5'-2" — 7'-6"
10'-4"	3.3	0.303	0.018	55	500	27,500	7-6" — 10'-4"

TOWN OF WILBRAHAM

Sheet No. 3

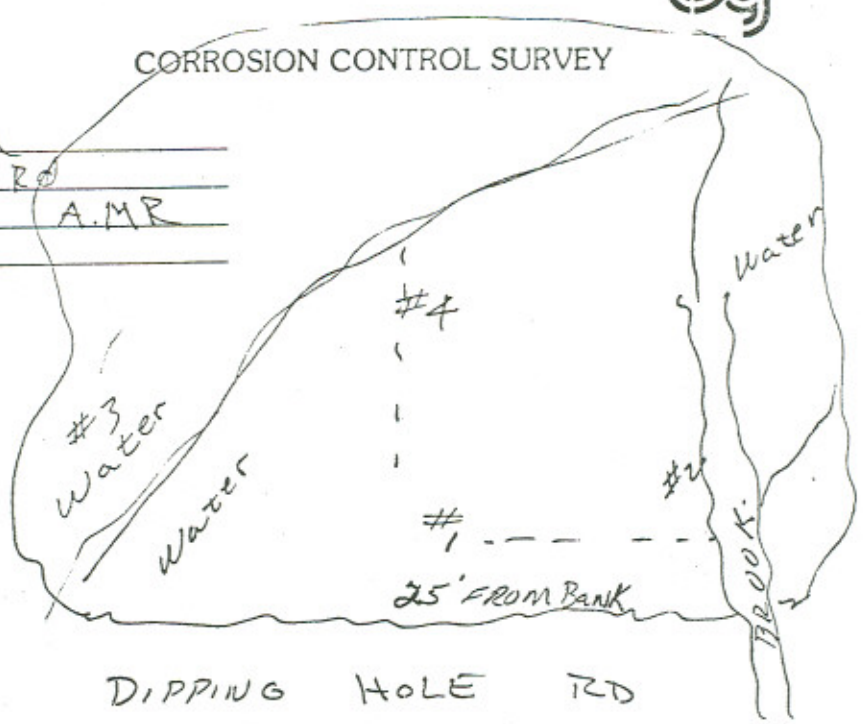



NET 3
PROPOSED RECTIFIER POLE
6" IP GAS
NET 2/25
HB
SB
12" HP GAS
MAIN ST.
TINKHAM ROAD
WILBRAHAM, MASS.
SCALE 1" = 40'

Bay State Gas

CORROSION CONTROL SURVEY

TOWN: Wilbraham
LINE: Dipping Hole Rd
TESTER: HAE A.MR
DATE: 6-21-79



Loc #	Pin Space	Meter Reading	X	Ω/cm 7000	Loc #	Pin Space	Meter Reading	X	Ω/cm
1	2'-6"	0.14	900	~~6300~~	2	2'-6			
1	5'-2"	0.72	1000	7200	2	5'-2"			
1	7'-8"	0.46	1500	6300	2	7'-8			
1	10'-4"	0.42	2000	7600	2	10'-4"	TO	WET	
1	13'-0	0.38	2500	9500	2	13'-0"			
1	15'-6"	0.38	3000	11,400	2	15'-6"			

Loc #	Pin space	Meter Reading	X	Ω/cm	Loc # 4	Pin SPACE	Meter Reading	X	Ω/cm	Fa
3			500		4	2-6	15	500	7500	to
3			1000		4	5-2	8.2	1000	8200	N
3			1500		4	7-8	6.4	1500	9600	1(
3	WET		2000		4	10'-4	5.7	2000	11,400	1(
3			2500		4	13'-0	5.0	2500	12,500	1(
3 TO			3000		4	15-6		3000	NOT TAKEN	

1 of 1

SOIL RESISTIVITY SURVEY & LAYER VALUE DETERMINATION

TOWN [illegible] LOCATION Dipping Hole Rd DATE 6-27-79 TESTER [illegible] Elliott
A. Rodrigues

4 PIN DATA					LAYER PROCEDURE					
									LAYER RESISTIVITY	
Location No.	Spacing Feet	R_1 ohms	Factor X	Resistivity ohm-Cm.	$1/R_1$ Mhos	$\Delta 1/R_1$ Mhos	R_2 $1/\Delta 1/R_1$ Mhos	Factor X	R_3 ohm-Cm.	Layer Depth Feet
	2'6"	14	500	7000	0.071	—	14	500	7000	0 - 2'6"
2	5'2"	7.2	1000	7200	0.139	0.068	14	500	7000	2'6" - 5'2"
	7'6"	4.6	1500	6900	0.217	0.078	12.76	500	6378	5'2" - 7'6"
	10'4"	4.2	2000	8400	0.238	0.021	47	500	23,462	7'6" - 10'4"
	13'0"	3.8	2500	9500	0.263	0.025	37	500	19,324	10'4" - 13'0"
	15'0"	3.8	3000	11,400	0.263					
	2'6"	15	500	7500	0.067	—	15	500	7500	0 - 2'6"
1	5'2"	8.2	1000	8200	0.122	0.055	18	500	9092	2'6" - 5'2"
	7'5"	6.4	1500	9600	0.156	0.034	29	500	14,598	5'2" - 7'5"
	10'4"	5.7	2000	11,400	0.175	0.019	51	500	25,722	7'5" - 10'4"
	13'0"	5.0	2500	12,500	0.200	0.025	40	500	20,000	10'4" - 13'0"

IMPRESSED CURRENT GROUNDBED DESIGN FOR MORE THAN ONE ANODE
SPRINGFIELD ST WILBRAHAM

Resistivity: 100000 ohm-cm

						TOTAL COST	
			MATERIAL COST				
Anode Type:			Anode:	0	ea.	$250.00	IN STOCK
Anode Dia:	4.5	in.	Anode Cbl:	0.1	$/ft	$2.00	IN STOCK
Anode Length:	1000	in.	Hdr Cbl:	1	$/ft	$0.00	
# of Anodes:	1		Splice:	15		$400.00	
Anode Spcng	1	ft.	INSTALLATION COSTS				
Dist. Remote	100	ft.	Trenching:	$3.50	$/ft	$0.00	*
			Anode Inst:	$333.33	per anode	$333.33	*
	SIZE		Splc Inst:	$25.00	per splice	$50.00	
Hdr Cable:	1	AWG	Power Cost:	$0.10	$/kwh		
			Electric	$850.00		$850.00	*
			Rectifier	$1,000.00		$1,000.00	*
Operating I:	30	amps(est)	Conservation	$1,200.00		$1,200.00	*
			PERMITS	$500.00		$500.00	*
			COPS	$350.00		$350.00	

GROUNDBED DESIGN RESULTS

Resistance:	-24.47127	OHMS	GROUNDBED COSTS		
Rect. Volts:	-734.1	volts	Materials:	$448.33	
Est. Amps:	10	amps	Install:	$420.83	
			Total	$3,919.17	$4,935.33

Header length 0

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF TELECOMMUNICATIONS AND ENERGY

RESPONSE OF BAY STATE GAS COMPANY TO THE
FIFTEENTH SET OF INFORMATION REQUESTS FROM THE ATTORNEY GENERAL
D. T. E. 05-27

Date: July 16, 2005

Responsible: Joseph A. Ferro, Manager Regulatory Policy

AG-15-10 Regarding MDTE No. 35, section 5.1, please provide the corresponding customer service policy and procedures.

Response: The Company's Policy and Procedures referenced in section 5.1 of M.D.T.E. No. 35 pertains to the Company's procedures in evaluating main and service line extensions. This line extension policy also relates to sections 5.8 and 5.9 of M.D.T.E. No. 35.

Please see response to UWUA-3-53 for a copy of the Company's procedure and instructions in evaluating whether the cost or investment to install mains and/or services to serve a customer or group of customers yields a reasonable rate of return, and if not a customer contribution will be required to raise the rate of return on the investment to the Company's required level. As the attachment presents, the Company uses a discounted cash flow ("DCF"), that is, a Net Present Value ("NPV") analysis.

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF TELECOMMUNICATIONS AND ENERGY

RESPONSE OF BAY STATE GAS COMPANY TO THE
EIGHTEENTH SET OF INFORMATION REQUESTS FROM THE D.T.E.
D. T. E. 05-27

Date: July 16, 2005

Responsible: Stephen H. Bryant, President

DTE-18-25 Refer to Exh. BSG/SHB-1, at 38. Please explain, in detail, the proposed financing for the 10-15 year steel infrastructure replacement program.

Response: Financing for all capital expenditures, including the steel infrastructure replacement program, will be funded through equity and long-term notes. Long-term sources of financing are issued/retained as long-term needs have occurred or are expected to occur.

Long-term notes are expected to be issued through NiSource Finance Corporation, which provides competitive rates to Bay State and allows Bay State to avoid significant issuance costs that would be incurred if the Company were to seek financing independent of NiSource. The notes may or may not be supported immediately with externally issued bonds at NiSource Finance Corporation.

Terms of these notes are anticipated to be market driven either through external issuances or set based upon H.15 statistical publications for appropriate lengths. The length of note, if externally issued, will be determined by Corporate Treasury after considering market rates, maturities of currently held debt, and other appropriate considerations.

Equity will be retained to the extent the Company will target a 45/55 debt equity ratio.

Financing petitions will be filed as long-term notes are requested. The DTE will review expected terms and requests at that time.

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF TELECOMMUNICATIONS AND ENERGY

RESPONSE OF BAY STATE GAS COMPANY TO THE
EIGHTEENTH SET OF INFORMATION REQUESTS FROM THE D.T.E.
D. T. E. 05-27

Date: July 16, 2005

Responsible: Stephen H. Bryant, President

DTE-18-26 Refer to Exh. BSG/JES-1, Sch. JES-17, at 9-10. Because the steel infrastructure replacement costs represent incremental capital expenditures, please explain whether any carrying charges and rate of return allowed by the Department should be calculated on an incremental cost basis, versus the embedded cost of capital.

Response: Exh. BSG/JES-1, Sch. JES-17, at 9-10 illustrates the cost to carry incremental investments made under the Company's proposed SIR program from the time the facilities are placed in operational service until the facilities are incorporated in rates through the annual SIR Base Rate Adjustment. This calculation utilizes the pre-tax, weighted average cost of capital as proposed by the Company in this proceeding. Needless to say, the Company intends to use the return that is ultimately granted in this proceeding.

As an alternative, it is certainly feasible to calculate carrying charges and rate of return for each annual SIR Base Rate Adjustment based on the Company's most recent debt issuance, rather than relying on the weighted average cost of long-term debt that existed at the time that the record was closed in this proceeding. In fact, the Company expects to issue additional long-term debt each year to finance the year's SIR program. The Company will require Department approval to issue this incremental debt. As such, the Department will know at the time of each annual SIR Base Rate Adjustment Filing the incremental cost of debt.

The determination of an appropriate equity rate at the time that each SIR Base Rate Adjustment is calculated is more difficult to determine. Unlike the cost of long-term debt, which will be determined at the time that incremental debt is issued and can readily be verified, there is no concise and independent method for determining an appropriate return on equity. As such, the Company would recommend that the return on equity as granted in this proceeding be used for calculations in SIR Base Rate Adjustment filings.

It would also be feasible to adopt the capital structure, as it exists from time to time, rather than rely on the capital structure that is approved in this proceeding.